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Description

SELF-LOCATING FASTENING ASSEMBLY AND METHOD FOR INTEGRATING A MONUMENT WITHIN AN AIRCRAFT

BACKGROUND OF INVENTION

[0001] The present invention relates generally to aircrafts and construction thereof, and more particularly to a self-locating fastening assembly for integrating a monument within an aircraft.

[0002] Aircraft manufacturers are well known for integrating a variety of monuments onto floors within the interiors of the aircrafts. Examples of these monuments include lavatories, galleys, closets, purser work stations, video control centers, and crew rests. Prior to installation, the mechanics ordinarily spend a substantial amount of time preparing the floor with liquid sealants. Thereafter, the monuments typically are installed onto secondary structural members, e.g. intercostals, between floor beams of the floor. In addition, a series of threaded fasteners usually

are utilized in combination with the secondary structures for securing the monuments to the aircraft. One skilled in the art will understand that a substantial number of these fasteners can be required for installing the monuments in the aircraft. For these reasons, the installation process can be a time-consuming and expensive.

[0003] It would therefore be desirable to provide an improved fastener assembly and method for installing monuments within aircraft interiors, especially an assembly and method that is less expensive and less time-consuming to install.

SUMMARY OF INVENTION

[0004] One embodiment of the present invention is a self-locating fastening assembly for aligning and securing a monument to an airframe of an aircraft. In this embodiment, the self-locating fastening assembly includes a socket member, which is fixedly coupled to one of either the airframe or the monument. The self-locating fastening assembly further includes a self-locating tie-down member, which is coupled to the other of the airframe or the monument. The self-locating tie-down member includes a base portion and a top portion extending from the base portion. The top portion is utilized for guiding the self-

locating tie-down member into the socket member. Also, the base portion is utilized for engaging the socket member so as to secure the monument in a predetermined position along at least one direction.

[0005] One advantage of the invention is that a self-locating fastening assembly is provided that can require a monument to be installed onto an airframe only within a predetermined position thereby improving quality assurance.

[0006] Another advantage of the invention is that a self-locating fastening assembly is provided that can minimize the need for jigs, fixtures, and other tools, which hold a monument in proper position for installation in an aircraft.

[0007] Yet another advantage of the invention is that a self-locating fastening assembly is provided that can decrease the wear experienced by various fastener-applicator tooling thereby decreasing maintenance of that tooling and costs associated therewith.

[0008] Still another advantage of the invention is that a self-locating fastening assembly is provided that can decrease the manufacturing cycle time and costs associated therewith.

[0009] Yet another advantage of the present invention is that a self-locating fastening assembly is provided that can

eliminate the need for threaded fasteners and decreases the number of secondary structural members required to install the monument in the aircraft.

[0010] Still another advantage of the present invention is that a self-locating assembly is provided that substantially decreases the amount of floor preparation required before installing the monument onto the floor.

[0011] Yet another advantage of the invention is that a self-locating fastening assembly is provided that eliminates tie-down attachments and/or threaded fasteners within the wet area under plumbed monuments, e.g. the galleys and the lavatories, thereby decreasing the risk of structural corrosion.

[0012] The features, functions, and advantages can be achieved independently and in various embodiments of the present invention or may be combined in yet other embodiments.

Brief Description of Drawings

[0013] For a more complete understanding of this invention, reference should now be made to the embodiments illustrated in greater detail in the accompanying drawings and described below by way of examples of the invention:

[0014] FIGURE 1A is a cross-sectional view of an airplane with a monument placed therein prior to utilizing a self-locating

fastening assembly to secure the monument to the airplane, according to one advantageous embodiment of the claimed invention;

[0015] FIGURE 1B is a cross-sectional view of the airplane shown in Figure 1A, illustrating the monument secured in place;

[0016] FIGURE 2A is a cross-sectional view of the airplane shown in FIGURE 1A, according to another advantageous embodiment of the claimed invention;

[0017] FIGURE 2B is a cross-sectional view of the airplane shown in FIGURE 2A, illustrating the monument secured to the airplane via the self-locating fastening assembly;

[0018] FIGURE 3A is an exploded view of the self-locating fastening assembly shown in FIGURE 1A, illustrating the self-locating fastening assembly including a self-locating tie-down member and a socket member;

[0019] FIGURE 3B is an assembled view of the self-locating fastening assembly shown in FIGURE 3A;

[0020] FIGURE 4 is a cross-sectional view of the self-locating tie-down member shown in FIGURE 3B, as taken along line 4-4;

[0021] FIGURE 5 is a cross-sectional view of the self-locating tie-down member shown in FIGURE 3B, as taken along line 5-5;

[0022] FIGURE 6 is a perspective view of the self-locating tie-down member shown in FIGURE 3A, illustrating an outboard-extending tab protruding from the self-locating tie-down member; and

[0023] FIGURE 7 is a logic flow diagram showing a method for utilizing the self-locating fastening assembly, as shown in FIGURES 1A and 1B, for installing the monument in the aircraft.

DETAILED DESCRIPTION

[0024] In the following figures the same reference numerals will be used to illustrate the same components in the various views. The embodiments described herein employ features where the context permits, e.g. when a specific result or advantage of the claimed invention is desired. However, a variety of other embodiments are contemplated having different combinations of the described features, having features other than those described herein, or even lacking one or more of the described features. Specifically, the embodiments described herein implement a self-locating fastening assembly for installing a monument within an aircraft. Yet, it is contemplated that the self-fastening assembly can be utilized for various other suitable applications and environments as desired. For

these reasons, it is understood that the invention can be carried out in various modes.

[0025] Referring to Figures 1A and 1B, there is shown a cross-sectional view of an airplane 10 with a monument 12 being secured therein via a self-locating fastening assembly 14, according to one advantageous embodiment of the claimed invention. This airplane 10 is comprised of an airframe 16 with an interior 18 and a floor 20 disposed within the interior 18. Also, the airframe 16 has one or more suitable engines 22 known in the art mounted thereon. Examples of the monument 12 include galleys, lavatories, closets, purser work stations, video control centers, crew work stations, and various other suitable monuments.

[0026] Specifically, Figure 1A illustrates the floor having a monument 12 placed thereon prior to securing the monument 12 to the floor 20. Additionally, Figure 1B illustrates the monument 12 moved across the floor 20 in a substantially outboard direction so as to utilize the self-locating fastening assembly 14 (detailed in the descriptions for Figures 3A-4) to secure the monument 12 to the floor 20.

[0027] In this embodiment, the self-locating fastening assembly 14 is comprised of a self-locating tie-down member 24,

which is coupled to the floor 20, and a socket member 26, which is coupled to the monument 12. The socket member 26 is utilized for receiving and engaging the self-locating tie-down member 24. In another embodiment exemplified in Figures 2A and 2B, the self-locating tie-down member 24" and the socket member 26" are instead respectively coupled to the monument 12" and the floor 20".

[0028] Referring back to Figures 1A and 1B, the socket member 26 is coupled to the monument 12 adjacent to an outboard edge 28 of a bottom surface 30 of the monument 12. In this respect, the central portion of the monument floor can remain intact without any threaded fasteners or other tie-down features comprising the structural integrity of that central portion of the monument floor. For that reason, plumbed monuments, eg. galleys and lavatories, can have uncompromised wet areas that do not leak and cause structural corrosion to the floor and other portions of the airframe.

[0029] However, it will be appreciated that the socket member 26 can be positioned in various other suitable locations on the monument 12 as desired. Furthermore, it is also understood that the socket member 26 can instead be de-

fined by the monument 12 itself and therefore be an integral part of the monument 12.

[0030] The self-locating tie-down member 24 is coupled to the floor 20 adjacent to a sidewall 52 of the airframe 16 and located in a predetermined position for inserting into the socket member 26. For this reason, the self-locating fastening assembly 14 can dispense with the need for jigs, fixtures, and various other tooling for precisely locating the monument 12 in the predetermined position. As a result, the self-locating fastening assembly 14 can decrease manufacturing cycle time, minimize costs associated therewith, improve quality assurance, and generally provide for lean manufacturing.

[0031] In addition, the self-locating fastening assembly 14 is utilized for fixedly attaching the monument 12 to the airframe 16 in the predetermined position along a forward direction, a rearward direction, an upward direction, a downward direction, an outboard direction, or any suitable combination thereof. However, it will be appreciated that the self-locating fastening assembly 14 can secure the monument 12 in more or less directions as desired. In this regard, substantially less secondary structural members and threaded fasteners can be required for securing

the monument 12 to the airframe 16 as would have otherwise been required without the self-locating fastening assembly 14. One skilled in the art will understand that this feature decreases the number of holes to be drilled, increases the life of drill tooling, decreases the amount of airplane floor preparation, minimizes the overall installation cycle time, lowers the costs associated therewith, and further provides for a lean manufacturing process.

[0032] Referring now to Figures 3A and 3B, there are respectively shown exploded and assembled views of the self-locating fastening assembly 14 shown in Figures 1A and 1B. As introduced above, the self-locating fastening assembly 14 includes a self-locating tie-down member 24 and a socket member 26 for receiving the self-locating tie-down member 24.

[0033] As best shown in Figure 3A, the self-locating tie-down member 24 includes a base portion 32 and a top portion 34 extending from the base portion 32. In this embodiment, the top portion 34 is comprised of an offset tab 36, which extends from the base portion 32, and a finger member 38, which extends from the offset tab 36. The offset tab 36 extends substantially perpendicularly from the base portion 32 with fillets 40 at the intersection be-

tween the offset tab 36 and the base portion 32. These fillets 40 strengthen the top portion 34 of the self-locating tie-down member 24. However, it will be appreciated that the offset tab 36 can extend from the base portion 32 by various other suitable angles with or without fillets 40 as desired. Furthermore, the finger member 38 extends substantially perpendicularly from the offset tab 36 and has a central axis, which is aligned with a longitundal axis of the base portion 32. In this way, the finger member 38 is positioned substantially parallel to the base portion 32 at a predetermined offset distance from the base portion 32. Yet, it is also contemplated that the finger member 38 can be positioned in a variety of other suitable orientations as desired.

[0034] In this embodiment, the finger member 38 has a generally conical shape that tapers in diameter from the offset tab 36. However, it is understood that the finger member 38 can have various other suitable shapes as desired. As detailed in the description for Figures 4-7, the finger member 38 is utilized for contacting the socket member 26 and inserting the self-locating tie-down member 24 into the socket member 26 to secure the monument 12 in the predetermined position.

[0035] Referring now to Figures 3A and 4, the base portion 32 is comprised of an inboard-extending tab 42, which protrudes substantially perpendicularly from the offset tab 36, and an outboard-extending tab 44, which protrudes from the offset tab 36 in a substantially opposite direction as the inboard-extending tab 42. However, it will be appreciated that the inboard-extending tab 42 and the outboard-extending tab can extend from the offset tab 36 by various other suitable angles as desired. Additionally, it is understood that the outboard-extending tab 44 can also be omitted as desired.

[0036] In this embodiment, the inboard-extending tab 42 and/or the outboard-extending tab 44 are coupled to the floor 20 within the interior 18 of the airframe 16 so as to guide the self-locating tie-down member 24 into the socket member 26 and locate the monument 12 within the interior in the predetermined position. However, it is understood that the base portion 32 can instead be coupled to various other suitable portions of the airframe 16 as desired. This is accomplished by a welding attachment, various other suitable fasteners, or any combination thereof as desired. It is also contemplated that the base portion 32 and the top portion 34 of the self-locating tie-down

member 24 can actually be a parts of the floor 20 or other portions of the airframe 16 themselves and therefore not require attachment by fasteners. As detailed in the description for Figures 5 and 6, the inboard-extending tab 42 is sized for inserting into the socket member 26 and securing the monument 12 to the floor 20 in the predetermined position.

[0037] As best shown in Figures 4 and 6, the base portion 32 further includes a reinforcing rib 46 coupled between the offset tab 36 and the outboard-extending tab 44. In this way, the reinforcing rib 46 strengthens the top portion 34 of the self-locating tie-down member 24. This feature is beneficial because it can prevent the top portion 34 from being deformed and being therefore improperly oriented for engaging the socket member 26 to the self-locating tie-down member 24 in the predetermined position.

[0038] Referring now to Figures 4 and 5, there are shown cross-sectional views of the self-locating fastening assembly 14, shown in Figure 3B, as respectively taken along lines 4-4 and 5-5. The socket member 26 includes a top chamber 48 and a base chamber 50 positioned adjacent to the top chamber 48. This further movement can indicate to an engineer or other installation operator that the monument

12 is substantially close to its ultimate predetermined position within the airframe 16. The base chamber 50 is sized for receiving the base portion 32 of the self-locating tie-down member 24, guiding the self-locating tie-down member 24 into the socket number 26, and restricting movement of the base portion 32 in one or more directions. To that end, the base chamber 50 has a tapered opening 50" for allowing a misaligned tie-down member 24 to automatically slide into correct alignment. Also, the base chamber 50 of the socket member 26 is utilized for preventing the base portion 32 of the self-locating tie-down member 24 from moving in a forward direction, a rearward direction, an upward direction, a downward direction, an outboard direction, or any suitable combination thereof. In other words, the base chamber 50 is utilized to restrict movement of the self-locating tie-down member 24 and the monument 12 attached thereto in one or more directions. As a result, the base chamber 50 of the socket member 26 can be utilized in combination with a substantially low number of fasteners, e.g. bolt fasteners, for securing the monument 12 in the predetermined position. Moreover, the top chamber 48 is utilized for receiving the finger member 38 and allowing the self-

locating tie-down member 24 to move closer toward the socket member in a fastening engagement. For instance, the top chamber 48 can receive the finger member 38 and allow the monument to move further outboard.

[0039] This self-locating tie-down member 24 is formed of a high-strength metal material by a die cast process. However, it will be appreciated that the self-locating tie-down member 24 can be compromised of various other suitable high-strength materials and can be manufactured by a steelmaking process, a rolling process, a forging process, an extrusion process, a drawing process, a welding process, or any combination thereof as desired. Furthermore, the socket member 26 is manufactured of a high-strength metal material by a drawing process. However, it is understood that the socket member 26 can be made of various other suitable high-strength materials and can be manufactured by a steelmaking process, a rolling process, a forging process, an extrusion process, a drawing process, a casting process, a welding process, or any combination thereof as desired.

[0040] Referring now to Figure 7, there is shown a logic flow diagram illustrating a method for utilizing the self-locating fastening assembly 14, shown in Figures 1A and 1B, to in-

stall the monument 12 in the airplane 10. As explained hereinabove, it is contemplated that the self-locating fastening assembly 14 can be utilized for securing a variety of items together other than the monument 12 and the airframe 16 of the airplane 10. The method commences in step 100 and then immediately proceeds to step 102.

[0041] In step 102, the monument 12 with one or more of the socket members 26 is placed on the floor 20 of the airplane 10 This step is accomplished by operating a forklift, a crane, a pulley mechanism, other suitable lifting devices, or any combination thereof to lift the monument 12 into the airframe 16 of the airplane 10. Then, the sequence proceeds to step 104.

[0042] In step 104, the monument 12 is moved in a substantially outboard direction along one or more guide lines (not shown) that are etched, scribed, or otherwise marked on the floor. In this way, the socket members 26 are moved in closer proximity to their respective the self-locating tie-down members 24. This step is accomplished by sliding the bottom surface 30 of the monument 12 across the floor 20 in the substantially outboard direction until no further movement is possible. However, it is understood that other suitable methods can be utilized for moving the

socket members 26 into a fastening engagement with the self-locating tie-down members 24. The sequence then proceeds to step 106.

[0043] In step 106, an engineer or other installation operator determines whether the socket members 26 on the monument 12 are properly aligned with their respective self-locating tie-down members 24. This step is accomplished by requiring the engineer to measure the gap between the monument 12 and a sidewall 52 of the airframe 16.

[0044] If this gap is substantially equal to the length of the finger member 38 or the outboard-extending tab 44 of the self-locating tie-down member 24, then the sequence proceeds to step 108. In step 108, the engineer determines that the monument 12 is not properly aligned for inserting the self-locating tie-down members 24 into their respective socket members 26. In that regard, the monument 12 is not positioned for being secured to the airframe in the predetermined position. For this reason, the engineer visually determines the locations of the socket members 26 in relation to their respective self-locating tie-down members 24 and then re-aligns the monument 12 accordingly. It is contemplated that various other suitable methods can be utilized for determining how to re-

align the socket members 26 with their respective self-locating tie-down members 24. Then, the sequence returns to step 104.

[0045] If, however, the gap is substantially shorter than the length of the finger member 38 and the outboard-extending tab 44, then the sequence proceeds to step 110. It will be appreciated that other suitable methods can be utilized for determining whether the socket members 26 are sufficiently aligned for receiving their respective self-locating tie-down members 24. In step 110, additional fasteners are applied to the monument 12 and the airframe 16 to secure the monument 12 to the airframe 16 in the predetermined position.

[0046] While particular embodiments of the invention have been shown and described, numerous variations and alternate embodiments will occur to those skilled in the art. Accordingly, it is intended that the invention be limited only in terms of the appended claims.